CLAIMS

<u>What is Claimed is</u>:

1   1.   An apparatus for adding auxiliary data D_A to an output data stream,

2   comprising:

3   a statistical multiplexer having a plurality of inputs including a first input, and an

4   output providing the output data stream;

5   a first encoder, having an output communicatively coupled to the a first statistical

6   multiplexer input, the first encoder for compressing a first data stream D_1 according to a

7   first actual data rate BW_{A_1} that is less than or equal to a first granted data rate

8   BW_{G_1} granted by the statistical multiplexer in response to a requested data rate BW_{R_1}

9   from the encoder, the difference between the first actual data rate BW_{A_1} and the first

10   granted data rate BW_{G_1} defining an encoder overhead rate BW_{OE1} such that

11      $BW_{G_1} - BW_{A_1} = BW_{OE_1} \geq 0$, the first encoder having an output including an compressed

12   version of the first data stream d_1 provided at the actual data rate BW_{A_1} and encoder null

13   data N_{E_1} at the overhead rate BW_{O1}; and

14   an auxiliary multiplexer, communicatively coupled to the statistical multiplexer,

15   for sensing encoder null data N_E and for substituting at least a portion of the auxiliary data

16   D_A for the encoder null data N_E.

1   2.   The apparatus of claim 1, wherein the auxiliary multiplexer is

2   communicatively coupled between the output of the encoder and the input of the

3   statistical multiplexer.

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1   3.   The apparatus of claim 1, wherein the auxiliary multiplexer is

2   communicatively coupled to the output of the statistical multiplexer.

1   4.   The apparatus of claim 3, further comprising a buffer, communicatively

2 coupled to the auxiliary multiplexer, the buffer for buffering the auxiliary data.

1   5.   The apparatus of claim 4, wherein the auxiliary multiplexer substitutes the

2 auxiliary data according to an unused memory of the buffer.

1   6.   The apparatus of claim 3, wherein the auxiliary multiplexer further senses

2 statistical multiplexer null data N_{SM} and substitutes at least a portion of the auxiliary data

3 for the multiplexer null data N_{SM}.

1   7.   The apparatus of claim 3, wherein:

2 the statistical multiplexer manages the presentation of the first encoder output

3 according to a first command input describing a target data rate of the output data stream

4 B_T; and

5 the auxiliary multiplexer is communicatively coupled to the statistical multiplexer

6 first input to command a change the target data rate of the output data stream B_T.

1   8.   The apparatus of claim 7, further comprising a buffer, communicatively

2 coupled to the auxiliary multiplexer, the buffer for buffering the auxiliary data, wherein

3 the auxiliary multiplexer changes the target data rate according to an unused memory of

4 the buffer.

1   9.   The apparatus of claim 7, wherein the auxiliary multiplexer changes the

2 target data rate according to one or more auxiliary data parameters selected from the

3 group comprising:

4   a minimum auxiliary data rate BW_{MIN};

5   a maximum auxiliary data rate BW_{MAX};

6   a nominal auxiliary data rate BW_{AVG} measured over a time period t_{per}; and

7   a priority.

1   8.   The apparatus of claim 7, wherein the change in the target data rate of the

2 output data is commanded to decrease the target rate of the output data stream B_T to

3 permit the substitution of auxiliary data D_A for the multiplexer null data N_{SM}.

1   9.   The apparatus of claim 7, wherein:

2   the auxiliary multiplexer further senses statistical multiplexer null data N_{SM} and

3 substitutes at least a portion of the auxiliary data for the multiplexer null data N_{SM}; and

4   the change in the target data rate of the output data is commanded to decrease the

5 target rate of the output data stream B_T to permit the substitution of auxiliary data D_A for

6 data selected from the group comprising the encoder null data N_{E_1} and the multiplexer

7 null data N_{SM}.

1   10.   The apparatus of claim 9, wherein the auxiliary data is added at a pre-

2 specified minimum auxiliary data rate.

1   11.   The apparatus of claim 3, further comprising:

2   a second encoder, having an output communicatively coupled to the a first

3 statistical multiplexer input, the first encoder for compressing a first data stream D_2

4 according to a first actual data rate BW_{A2} that is less than or equal to a first granted data

5 rate BW_{G2} granted by the statistical multiplexer [in response to a requested data rate

6 BW_{R_2} from the encoder, the difference between the first actual data rate $BW_{A_{21}}$ and the

7 first granted data rate BW_{G_2} defining an encoder overhead rate BW_{O2} such that

8 $BW_{G_1} - BW_{A_1} = BW_{O_2} \geq 0$, the first encoder having an output including an compressed

9 version of the first data stream provided at the actual data rate $BW_{A_{21}}$ and encoder null

10 data N_{E_1} at the overhead rate BW_{O2}, the second encoder having an output;

11   wherein the statistical multiplexer allocates data presented at the plurality of

12 inputs to the statistical multiplexer output according to a statistical multiplexer second

13 command input; and

14   wherein the auxiliary multiplexer is communicatively coupled to the statistical

15 multiplexer second input to command a change in the allocation of the data presented at

16 the plurality of inputs to the statistical multiplexer output.

1   12.   The apparatus of claim 11 wherein the auxiliary multiplexer changes the

2 allocation of the data presented at the plurality of inputs to the statistical multiplexer

3 output according to an unused memory of a buffer communicatively coupled to the

4 auxiliary multiplexer, the buffer for buffering the auxiliary data.

1   13.   The apparatus of claim 12, wherein the multiplexer changes the allocation

2 of the data presented at the plurality of inputs to the statistical multiplexer output

3 according to an unused memory of the buffer.

1   14.   A method of adding auxiliary data D_A to a data stream, comprising the

2   steps of:

3   accepting a statistically multiplexed data stream having null data; and

4   substituting at least a portion of the auxiliary data D_A for the null data in the

5   statistically multiplexed data stream.

1   15.   The method of claim 14, wherein the auxiliary data D_A is non-

2   opportunistic data.

1   16.   The method of claim 15, further comprising the step of:

2   buffering the auxiliary data D_A until there is sufficient null data to permit the

3   substitution of the at least some of the auxiliary data D_A in the statistically multiplexed

4   data stream.

1   17.   The method of claim 16, further comprising the step of:

2   controlling an amount of the null data in the statistically multiplexed data to

3   provide sufficient null data to permit the substitution of at least some of the auxiliary data

4   D_A in the statistically multiplexed data stream.

1   18.   The method of claim 17 wherein the amount of null data is controlled

2   according to a relationship between an amount of the buffered auxiliary data D_A and a

3   capacity of a buffer storing the buffered data.

1   19.   The method of claim 17, wherein the null data comprises statistical

2   multiplexer null data N_{SM}.

1   20.   The method of claim 18, wherein the statistically multiplexed data stream

2   is statistically multiplexed to a throughput less than or equal to a target throughput value

3   BW_T, and the step of controlling an amount of null data in the statistically multiplexed

4   data comprises the step of altering the target throughput value BW_T.

1   21.   The method of claim 17, wherein the null data comprises encoder null data

2   N_E.

1   22.   The method of claim 21, wherein the statistically multiplexed data stream

2   is statistically multiplexed according to a statistical multiplexer equation, and the step of

3   controlling an amount of null data in the statistically multiplexed data according to a

4   relationship between the amount of buffered auxiliary data D_A and a capacity of a buffer

5   storing the buffered data comprises the step of altering the statistical multiplexer

6   equation.

1   22.   The method of claim 17, further comprising the step of:

2   examining the auxiliary data D_A for non-essential data; and

3   eliminating the non-essential data from the auxiliary data D_A before substituting

4   the auxiliary data D_A for the null data in the statistically multiplexed data stream.

1   23.   The method of claim 17, wherein the step of amount of null data in the

2   statistically multiplexed data is controlled according to a parameter set describing the

3   auxiliary data D_A, including:

4   a minimum throughput required to keep the data service active BW_{MIN};

5   a maximum sustained throughput of the data service BW_{MAX}; and

6   a nominal or guaranteed rate over a time period BW_{AVG}.

1   24.   The method of claim 14, wherein the data stream comprises a set of data

2   packets all having a packet ID including a first data packet and a second data packet

3   temporally adjacent the first data packet, and the step of substituting at least a portion of

4   the auxiliary data D_A for the null data in the statistically multiplexed data stream

5   comprises the steps of:

6   substituting at least a portion of the auxiliary data D_A for the data in the second

7   data packet if the first data packet includes at least a number NB consecutive zero data

8   values and the second data packet includes all zero data values.

1   25.   A system for transmitting auxiliary data D_A packetized satellite signal,

2 comprising:

3   a statistical multiplexer having a plurality of inputs including a first input, and an

4 output providing an output data stream;

5   a first encoder, having an output communicatively coupled to the a first statistical

6 multiplexer input, the first encoder for compressing a first data stream D_1 according to a

7 first actual data rate BW_{A_1} that is less than or equal to a first granted data rate

8 BW_{G_1} granted by the statistical multiplexer in response to a requested data rate BW_{R_1}

9 from the encoder, the difference between the first actual data rate BW_{A_1} and the first

10 granted data rate BW_{G_1} defining an encoder overhead rate BW_{OE1} such that

11 $BW_{G_1} - BW_{A_1} = BW_{OE_1} \geq 0$, the first encoder having an output including an compressed

12 version of the first data stream d_1 provided at the actual data rate BW_{A_1} and encoder null

13 data N_{E_1} at the overhead rate BW_{O1}; and

14   an auxiliary multiplexer, communicatively coupled to the statistical multiplexer,

15 for sensing encoder null data N_E and for substituting at least a portion of the auxiliary data

16 D_A for the encoder null data N_E;

17   a modulator communicatively coupled to the auxiliary multiplexer, for modulating

18 the output data stream;

19   a transmitter, communicatively coupled to the modulator for transmitting the

20 output data stream; and

21   a transponder, for receiving the transmitted modulated output data stream and for

22 retransmitting the received output data stream to a subscriber.